

Global Platform for Rich Media Conferencing and Collaboration

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The next generation of HENP (High Energy and Nuclear Physics) experiments largely involve dispersed collaborative environments, supporting point to point and multipoint videoconferencing and application sharing. Since 1995, The "Virtual Rooms Videoconferencing System" (VRVS) is being developed by Caltech (California Institute of Technology) in order to provide a low cost, bandwidth-efficient, extensible means for videoconferencing and remote collaboration over networks within the High Energy and Nuclear Physics community and with extensions also to other research communities. VRVS supports full connectivity to Access Grid through the VRVS AG Gateway, where the VRVS users can easily connect to the Virtual Venues or any multicast videoconference. In February, the new VRVS version 3 has become the production system. Its key points are robustness and scalability: thousands of users connected to hundreds of meetings at the same time. The new design of the system enables a comfortable integration of new tools, clients, emerging standard, and a backup routing path between Europe and America. VRVS continues to expand and implement new digital video technologies. Further aspects include among others: SIP, Pocket PC platform support and services (based on the MonALISA¹ project) to monitor real-time activity, oversee and manage the whole distributed system in a dynamic way.

1. INTRODUCTION

The Caltech "Virtual Rooms Videoconferencing System" (VRVS) (<http://www.vrvs.org>) has become a standard part of the toolset used daily by a large sector of HEP, and it is used increasingly for other DoE-supported programs. It has also attracted substantial interest in diverse fields of science and engineering outside the HEP. The relationship with Internet2 and other international organizations has been consolidated.

The development of the next generation of the VRVS system is currently underway; details are described in latter sections of this document. As a software-based collaborative infrastructure, VRVS is now recognized as a great application capable of scaling to provide future collaboration services throughout these organizations.

2. THE VRVS PROJECT

The VRVS system is managed by the Caltech CMS group. Since last year, the number of multipoint collaborative sessions (national and international) using VRVS increased by 180% mainly pushed by the successful transition to the new version, where a nearly unlimited set of virtual rooms is available. This large adoption rate confirmed the need within the Research and Academic communities for easy-to-use collaborative tools with high performance.

As part of the Internet2 Commons initiative, Internet2 and the VRVS Caltech Team continue to deploy a series

of VRVS servers (currently 11), known as reflectors, over the Abilene Backbone and Internet2 Universities. The objective is both to provide better performance for existing VRVS users, and to facilitate access by new users. VRVS uses the Internet2 and ESnet high-performance networks infrastructure in the US to deploy its Web-based system. By now, there are 70 reflectors that manage the traffic flow, as depicted in Figure 1.



Figure 1 – VRVS Reflectors Topology

VRVS is also involved in the Global Grid Forum initiative, where new services are starting to be developed, based on the Open Grid Services Infrastructure (OGSI). Among these services, there are plans to monitor real-time activity of the system, oversee and manage the VRVS distributed network. This will make VRVS collaboration a persistent part of the overall Grid standards-based working environment that is currently being developed by the HENP community.

¹ MonALISA stands for Monitoring Agents in Large Integrated Services Architecture

2.1. VRVS Version 3

The VRVS site is designed to allow fast and intuitive navigation. Based on the “Virtual Rooms” concept, distributed users can meet in virtual spaces to collaborate. For a few years now, VRVS has provided a web based booking system where the participants can reserve meetings manually or through a “booking wizard”, protect meetings with a password, check their latest bookings or the daily booked ones, etc. Also, during the meetings, a chat and a sharing service are available for easier collaboration.



The screenshot shows the VRVS web interface in a browser window. The title is "List of ongoing Meetings" for Thursday, May 22, 2003. The interface includes a sidebar with icons for Download, Booking, Virtual Rooms, Private, and 100000. The main content area displays a table of ongoing meetings.

Virtual Rooms	Started	Finish at	Subject	Options
Desert	13:30	14:50	UCL-ATLAS-OpenShift Project Overview	
Forest	16:00	16:50	Business	
Island	16:00	17:50	ATLAS 199 Weekly	
Mountain	08:30	17:50	MOA collaboration meeting	
Ocean	15:30	18:20	UCL 100	
Bay	15:30	18:20	UCL 100 Meeting	
Marsh	16:00	17:50	CHRM COOLCOOLROOM	
Moors	14:30	17:20	CHRM DAG	
Stephens	14:00	18:50	UCL Collaboration	
Station	16:00	17:50	UCL 100	
Sea	15:30	18:20	UCL 100 Meeting	
Yarns	14:30	16:20	VRVS-SE	
Beach	15:00	06:50	VRVS-SE weekly	
Car	15:00	18:00	Current Topics, J. J. J. J. J.	
Cafe			UCL 100	

Figure 2 – Typical Ongoing VRVS Meetings

Since mid-February 2003, a new version of VRVS (version 3) has been successfully deployed. At the present time, more than 4,000 users from 81 countries have registered and used the new version of VRVS. There are currently 70 reflectors to interconnect and manage the traffic flow worldwide. Recently, new reflectors have been installed in Belgium, Brazil, France and China. Also, 5 new reflectors have been deployed in several US universities using the Internet2 Backbone.

In addition to improving dramatically the scalability and usability, the new release brings new features and capabilities. Tunneling between peer reflectors, NAT support, integration of the VNC sharing service through the reflectors, improvements in the booking system and user profiles, Mac OS X support are part of the new features available. In addition, the world time zones are now automatically managed by the system, so each user will see the time in their local time zone, regardless of their location.

All these aspects have been integrated gradually and smoothly, driven by the user needs and demands. For a few months both VRVS 2.5 and 3 versions ran in parallel. During that time, the users were able to test the new system, get used to it and to its features. This transition let us fix small problems that were detected and reported. At the end of this transition period, the switch was completed and the result was a near-perfect

migration of thousands of users from two completely different systems, without any major problem.

2.2. The VRVS AG gateway

With VRVS 3, the VAG (VRVS AG Gateway; or Virtual Access Grid) has been improved based on users experience and feedback. The new VAG has full connectivity to Access Grid and full functionality. VAG give users a minimal learning curve, and supports combined multicast-and-unicast collaborative sessions. The VAG has been shown to support a full Access Grid session on a laptop, consuming a few Mbps of bandwidth (or less, under user control), and can run over 802.11a or 802.11g wireless networks without packet loss. VAG reflectors have been installed in Internet2, and at Argonne National Laboratory, and will be deployed on institutional AG nodes as needed, based on users' requests. A VAG reflector is functionally identical to other VRVS reflectors and is very easy to configure.

To connect to Access Grid Virtual Venues or any multicast videoconferencing, VRVS users only need to login to VRVS 3, and within 5 intuitive clicks, the user is ready for a collaborative session that includes both AG and other VRVS participants. VRVS users have the maximum flexibility to choose from UCL Mbone, OpenMash Mbone, H.323, SIP, QuickTime, JMF (Java Media Framework) on various platform including Linux, Windows and Mac OS X. The audio transcoder has been improved to transcode AG linear L16-16-Mono to the ITU H.323 standard G.711 μ -Law.



Figure 3 – VRVS-AG Gateway

An audio mixer feature is implemented to support H.323 audio mixing and avoid blocked video because of a noisy site injecting noise into the session. The new VAG also supports a useful range of video modes, particularly to accommodate VRVS users with limited local network and/or CPU power capacity. Specifically, VRVS provides four video modes: (1) Voice switched - the default mode for H.323 clients, receiving one video stream at a time; (2) Timer switched - one browses through all the video based on preset timer, receiving one video stream at a time; (3) Selected Streams - the default mode for Mbone clients. Click among the video participants to view selected video streams (one or several streams are available), which is useful for limited bandwidth network connections and/or legacy low-power local computing systems; and (4) All Streams - Mbone will receive all the video streams subscribed to the virtual venue multicast address. This is the best mode for full interactivity, if the network will support the data flow.

3. VRVS AS A UNIQUE SYSTEM

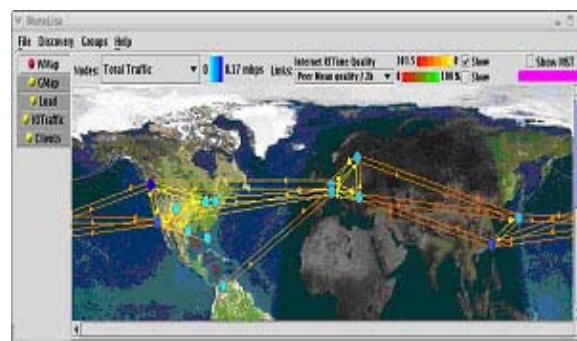
At the present time, VRVS supports inter-connectivity among the most popular videoconferencing tools running on different operating systems either over unicast or multicast networks. The reflectors' backbone provides a pure software-based MCU with peer to peer structure using a sophisticated real time multipoint algorithm with low cost and maintenance. In this area, one of the future improvements we are already working on is the real time monitoring of reflectors, dynamic interconnection of reflectors based on detection of problems and system optimization, and alarm notification tools. All these features are based in the Caltech MonALISA project later described in this article. At a later date, we will also consider migrating some of these characteristics to the Open Grid Services Architecture.

4. NEXT DEVELOPMENTS

We are currently working on the integration of privileged users as sessions' chairmen, to mute/unmute the video/audio of any participant in real time, decide who the speaker is and which video should be received by remote participants.

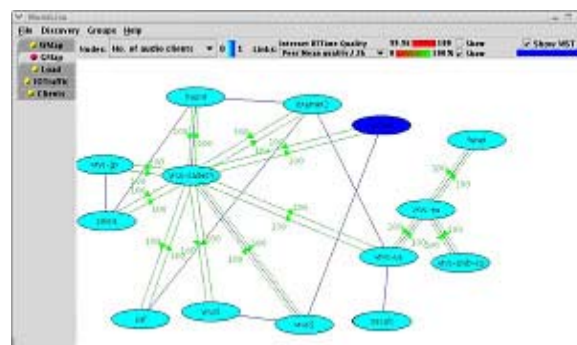
Other enhancements are the full integration of the SIP protocol, automatic upgrade of VRVS reflectors using encryption and authentication, full compliance with IPv6, encryption of communications among reflectors, development of new high end videoconferencing services based on MPEG and/or HDTV, start the interoperability of handheld devices and provide powerful monitoring and tracking tools of VRVS usage (per user/ per reflector, per hour, etc.)

Following the release of VRVS 3, the major new development has been the integration of the MonALISA monitoring service into the VRVS system. MonALISA was adapted and deployed on the VRVS reflectors. Dedicated modules to interact with the VRVS reflectors were developed: to collect information about the topology of the system; to monitor and track the traffic among the reflectors and report communication errors with the peers; and to track the number of clients and active virtual rooms. In addition, overall system information is monitored and reported in real time for each reflector: such as the load, CPU usage, and total traffic in and out.



For each VRVS reflector, a MonALISA service is running as a registered JINI service. For the VRVS version the MonALISA service is used with an embedded Database, for storing the results locally, and runs in a mode that aims to minimize the reflector resources it uses (typically less than 16MB of memory and less than 1% of the system load.)

This GUI provides real time information dynamically for all the reflectors which are monitored, as illustrated in Figures 4 and 5.



If a new reflector is started it will automatically appear in the GUI and its connections to its peers will be shown. Filter agents to compute an exponentially mediated quality factor of each connection are dynamically

Mbs (to 4-5 Mbps in practice) sending full audio and video streams over a wireless connection is now practicable. More cameras for handheld computers are coming on the market every day. These cameras work at faster frame rates and higher resolutions than before, and more videoconferencing clients for handheld computers are becoming available. There are now H.323 and SIP clients for handheld computers which could be integrated into VRVS. This would make VRVS more of a ubiquitous tool for physics collaborations at work.

A prototype of a VRVS audio/video client that runs on a Pocket PC has been implemented (Figure 7.). It supports the standard H.261 CIF video and G.711 μ -Law audio. We still need to construct interfaces to run on the smaller screen space but include all the controls we have for all the clients (meeting scheduler, chat, etc).

To help enable seamless collaboration we can now allow mobile individuals to connect as a group in a meeting. Using wireless handheld computers with audio and video capabilities anyone in a group will be able to participate in a meeting at any time anywhere.

We are developing agents able to provide an optimized dynamic routing of the videoconferencing data streams. These agents require information about the quality of alternative connections in the system and they solve a minimum spanning tree problem to optimize the data flow at the global level. These agents are capable to take system actions and may be dynamically loaded and digitally signed by developers with trusted certificates (for security reasons).

4.2. Pocket VRVS

Pocket VRVS 11:37a

Pocket VRVS

2000 images in 10.00 seconds

Participants COFFEE

PocketPC@121.215.144.7
 mic@130.199.101.96g156
 juliano@131.215.145.30
 healy@130.199.130.72

Video 237.6 Kbps
 [Green bar]
 [Green bar]
 [Green bar]

Control Audio Video Camera About MAX

Figure 7 – VRVS in a Pocket PC.

The VRVS Team will continue to develop and expand the system with new available technologies, adding, among others features, the ones described in this document to provide the most powerful tool available for collaborative environments. This tool provides a unique, independent, flexible and scalable platform, for a professional collaborative experience.

References

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- [5] VIC, <http://www-nrg.ee.lbl.gov/vic/>
- [6] AccessGrid, <http://www.accessgrid.org/>